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IN
INDIVIDUAL PHASES

by

Prof. B. GOTTLIEB, Tel-Aviv

Dr. H. C. Loyola Univ. Chicago

I.

THE TREATMENT OF ROOT CANALS

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Prof. B. GOTTLIEB, Tel-Aviv

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Dedicated to my co-workers, the world over, with the best of wishes.

FOREWORD

During the past twenty years, I have endeavoured in conjuncion with a number of co-workers to explore and investigate the foundations of several provinces of dentistry. At the same time, I have taken pains to make use of the findings of those investigations in practice. No finding was considered satisfactory unless it passed the tests at both ends of this double-control system.

In my opinion it is now time to give publication to these findings. The decision to publish them in the form of individual monographs is due mainly to the fact that in this form of presentation they are believed to serve best as a post-graduate help to the practicing dentist. Accordingly, very little that can be of use to the beginner will be found therein.

The requirements of the general practictioner is of formost consideration in these presentations. In the case of a special procedure however, the scientific foundations for it will be quoted and illustrated.

It is my predominant aim to give the reason and proofs for each special procedure. I consider myself just as failible as any other person. Stating the reasons for the procedure in question, facilitates any change made necessary in the light of new knowledge. Surely we must be conscious of the fact that all conceptions with the exception of ethics are in need of correction, the moment that the underlying basic knowledge has undergone an acknowledged change. In civilization each acquired knowledge of a generation is but another step upon which mankind remains until he can attain the next hight. It is an advantage to the development of knowledge that we recognize this fact, and that we do not ascribe eternity to a present day knowledge in presenting it.

In the distribution of the material we were torn between the desire on the one hand to group all the relevant and pertinent ones together and on the other hand to keep the individual monographs as equal as possible in their extent.

The following subjects are included in the monographs:

1. Root Canal Treatment.
2. Inlays Pinlays, ¾ Crowns, Fixed Bridge-Work.
3. Partial and Full Dentures.
4. Caries, Plastic Fillings and Ceramics.
5. Inflammation of the Gums and loosening of teeth. (In collaboration with Dr. B. Orban, Chicago.)

Those monographs, that deal with mechanical problems as well, have received the cooperation and assistance of Lorenz Hirsch, Tel-Aviv, and the titles of those monographs bear the notice "with cooperation of L. Hirsch".

It is my heart's desire and sacred duty to express my profoundest thanks to Miss Marie Zurek, Vienna, my scientific secretary for many years, for all the help she has given me throughout the years of our association, and especially for her support during the composition of the first monographs, which were completed under particularly difficult circumstances.

I.

THE TREATMENT OF ROOT CANALS

English edition by Dr. S. Lewin-Epstein, Jerusalem

INDEX

1. Introduction

Historical retrospect 9
Focal infection 9
Histological control of methods of root canal treatment . 10
Social aspects 13
2. The treatment of pulps accidentally exposed . . . 13
3. The technic of pulp extraction 14
Technic of anaesthesia 15
Rubber dam 16
Trepanning 17
Technic of pulpextraction 18
Drainage of canals by suction with the Seidner apparatus . 21
Root canal filling 23
Production of dentin powder 25
4. Pulpitis 26

5. Treatment of infected root canals

Radiological control 27
Judging of chances for retention 27
Grinding away the remains of crown 28
Making the pulp chamber air-tight for suction . . . 28
Technic of treatment 28
Ionization 30
Second sitting 32
Actions of eugenol and formalin preparations . . . 33
Final sitting 34

6. Extraction of infected teeth

Technic of tooth extraction 34
Preservation of surgical instruments 36
7. Focal infection and pyorrhea 37
8. Cysts 38

1. INTRODUCTION.

HISTORICAL RETROSPECT:

When our antecedents, the dentists of about eighty years ago, conceived the idea that we could retain even those teeth whose pulps were exposed, they rightly acclaimed this fact as a considerable advance. Various authors laboured to improve and complete these methods so as to make them clinically reliable. Later, attempts were made to retain teeth with devitalized pulps as well and this also succeeded in progressive measure. In both developments the standard requirements were that the treated tooth caused no subjective local complaints and were functioning properly.

FOCAL INFECTION:

When dentistry began to find application for the use of X-ray technic and was able to control treated teeth radiologically, they realized that in many cases a periapical absorption of bone was to be identified. It was further established that some ailments were connected with apically infected teeth whose removal was followed by a striking improvement in the condition of the illness. In connection with this it was especially established as not uncommon for infected teeth, suspected of a connection with a general systemic ailment, to be extracted, without any beneficial results ensuing. Confusion followed for which this fact was mainly responsible, that only then could a connection be established with a general systemic ailment when the removal of a devitalized tooth was followed by an improvement in the condition of the illness. But, even in negative cases the supposition remained that the new focus (secondary focus) although originally caused by the tooth infection had made itself independent and accordingly the extraction of the offending tooth was without effect upon the condition of the now independent focus.

In view of this accumulated knowledge, it is comprehensible that wide circles of medicine and dentistry, represented the viewpoint, — and still do to-day — that it is by far safest to do no root canal treatment at all, and in the case of an accidental exposure of the pulp or the establishing of the death of a pulp, to extract the tooth in question. Accordingly, no opposite viewpoint, that was not incontestably established could hold its ground. It was all the more necessary to bring incontestable scientific proof, that we were in a position to carry out a reliable root canal treatment with a definite technic; a treatment that we could assure causes no harm to the organism. It is quite generally known that attempts to solve this problem were made in various ways. The results brought to light were sometimes contradictory and in no way reliable enough as to find general employment. Thus, for example, in a bacteriological examination one is forced to accept the results of a certain technic, withouth being able to control the aforementioned examination at any future date.

HISTOLOGICAL CONTROL OF METHODS OF ROOT CANAL TREATMENT.

Histological control has this advantage, that histological preparations may be viewed and controlled at any time for years to come. Our only concern was to find a suitable animal and to establish if the tissues of this experimental animal are at least as sensitive as human tissues. We were able to etablish that the dog's teeth showed incomparatively more ramification of the pulp than did the human teeth. Some authors even suggested that, the canine periapical tissues being so much more sensitive than the human, the dog should not be considered useful for this type of experiment. This unanimous establishment gave the assurance that a method of root canal treatment that could stand the test in the case of a dog's tooth could be used with absolute safety on human teeth *).

While the pulp extraction in the case of the dog could be carried out similarly as in humans, the infection of the root canals and the formation of a periapical focus of infection had yet to be tried out; that is to say it had to be established with certainty how long it took the periapical inflammation with its incipient tooth resorption to set in. The next point to be established was the fact that it was indispensably necessary to extract the pulp, as

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*) One part of the experiments on animals was carried out in conjunction with Dr. B. Orban, Chicago. My secretary for many years, Miss Trude Susstrunk, has assisted me in all the experiments on animals in a most self-sacrificing manner. I take this opportunity of expressing to her my profoundest thanks for this unselfishness.
The scientific commission of the F.D.I. has taken great pains during many years to advance the solution of this problem, and for this solution has set aside a considerable sum of money. In some countries, however, this called out a reaction towards animal experiments and it appears that the F.D.I. refused to be made a party to such a conflict and withdrew.

not every opening of the pulp chamber led to the death of the pulp; it was far oftener the case that a demarcational inflamation developed along the length of the pulp itself, so that the advance of the infection up to the apex may be prolonged for an uncontrolable length of time. Whereas, through the extraction of the pulp up to the apex, we have created a dead area, incapable of reactions, and experience teaches us that six to eight weeks suffice to usher in an incontestable periapical infiltration accompanied by an incipient resorption at the apex. This is the time required in order to insure apical involvement in all cases. In some cases at the end of that time we find a considerable focus of infection and sometimes even an abscess. Thus, in beginning our treatment two months after the extraction of the pulp, we are reasonably certain that we are dealing with an infected canal and a periapical inflammation.

A deliberate infection of the root canals after the extraction of the pulp is unnecessary; it is sufficient to close the openings of the canals with a pellet of cotton. In this manner you reproduce the condition of the human mouth. The microorganisms of the mouth through the agency of the mouth fluids force their way into the empty canals, incapable of reaction and there, in all probability become virulent, and, as in man, produce a periapical infection and inflammation.

To start with, we had no conception of the capacities for reaction possessed by the periapical tissues. Our sole effort was to be able to bring the histological finding to a point where no inflamed tissues could be found in the periapical area. The essence of this control is that the periapical connective tissue is to a certain extent considered as a culture medium. If this connective tissues cannot be induced to produce any appearance of inflammation either by the agency of medicaments, or through bacterial irritation, then we may say that no damage exists. This control through the living connective tissues of an experimental animal appears to be the most reliable method of control, in fact, so reliable as to hardly warrant discussion.

During the course of the investigation still other aspects made their appearances. First of all in the case of extraction of the pulp it was of importance to establish, how any given method would operate when the pulp canal was in direct connection with the periapical connective tissue. In the case of the dog, on account of its ramification the pulp canal is without exception separated from the connective tissue, so that no connection is established with the periapical connective tissue throughout the manipulations in the pulp canal. We now had to drill through the tooth to this area, and at once it was evident, that we must use a much more pretentious method, if we are to come in direct contact with the periapical tissue and if we were to care for injuries to the connective tissue. The change made in the procedure of the experiment by this drilling was necessitated by the fact that in the human mouth it was not at all uncommon to come in contact with the periapical connective tissue during pulp extraction.

The claims that we had to satisfy in the treatment of a periapical focus of infection took on a much more complicated form, and aspects developed that we could in nowise anticipate. We could form no clear picture of what happened to the necrotic root surfaces, nor could we imagine what might be expected from branchings of the root canals, that harboured dead tissue. It was demonstrated that soon after sterilizing and freeing these dead tissue of germs, the neighbouring inflamed connective tissue regained health, and almost at once deposited cementum upon the necrotic surfaces of the tooth. This cementum may also close up the apical foramina, and thus produce a complete surface consisting of living cementum, which removes completely every doubt concerning retention of such a tooth.

Fig. 1 and 2 show drill punctured root apices of a dog. The teeth were infected 2½ months before the treatment, and the animals were sacrificed about 5 months after the filling of the root canals. You can see a layer of new vital cementum deposited upon the partly resorbed necrotic root surfaces, which also seals the drill punctured apical foramen. Fig. 3 of the same tooth as Fig. 1 shows in addition to the covering over of necrotic celless

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Fig. 1. The tooth was treated two and a half months after the infection, and five months after the root canal filling the animal was sacrificed. During treatment the root was drilled through the apex. Covering the partially resorbed necrotic cementum (a) a layer of vital cementum (b) can be seen, which also covers the artificial opening. Periapical tissue completely without reaction.

Fig. 2. A second tooth of the same animal as in Fig. 1. Conditions resemble those of Fig. 1.

Fig. 3. Tooth of a dog. Side canal (a) has a covering of newly formed cementum, which merges into the hood of cementum covering the necrotic surface.

Fig. 4. Higher magnification of section of Fig. 2. The necrotic cementum with its empty lacunae (a) is covered over by a layer of vital cementum with cement corpuscles (b).

Fig. 1

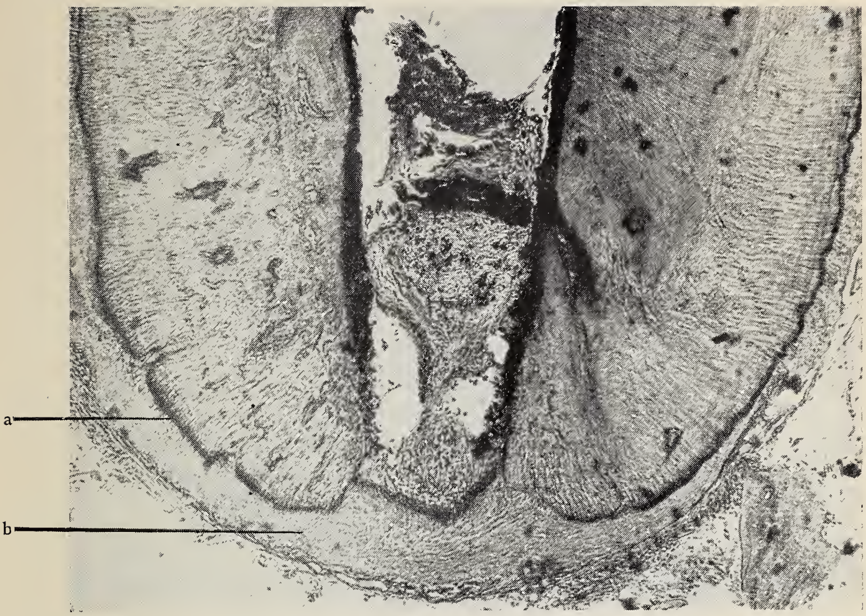


Fig. 2

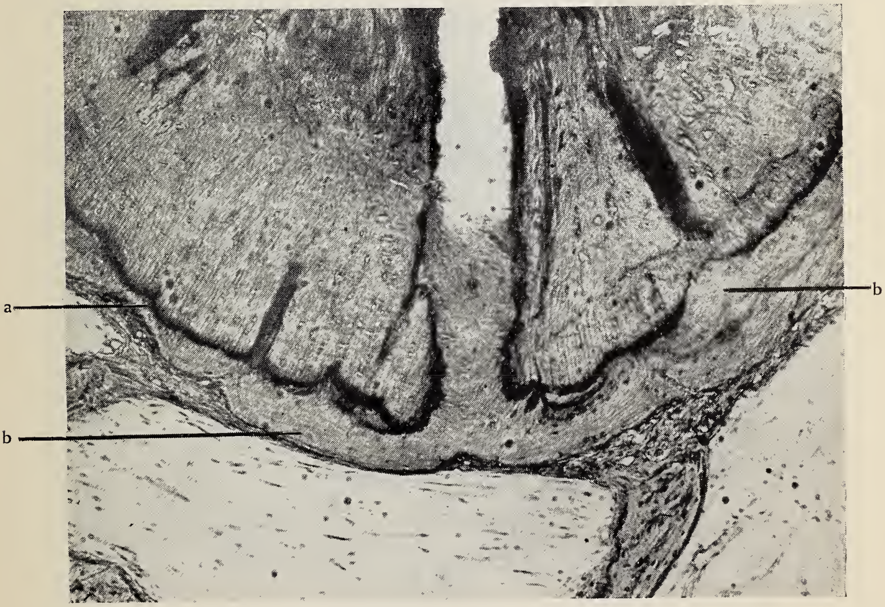


Fig. 3

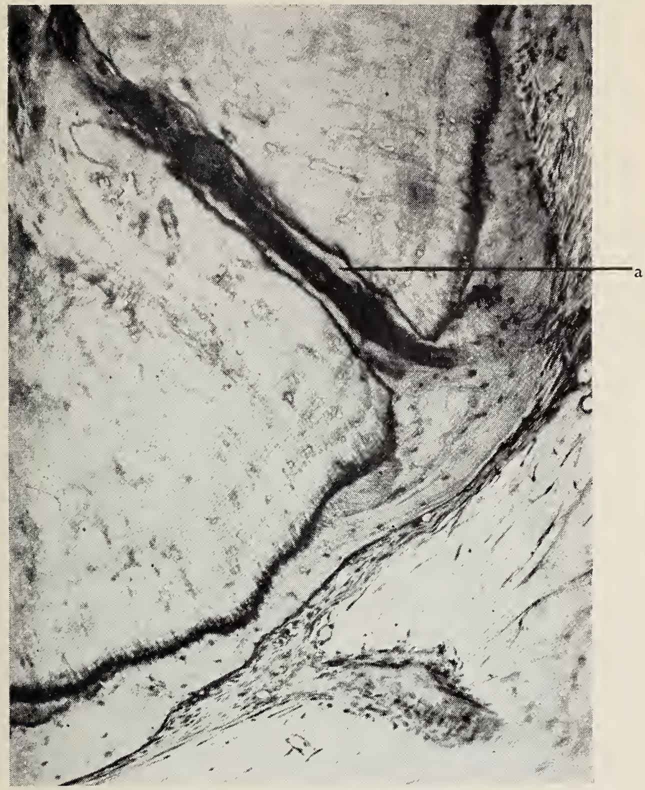
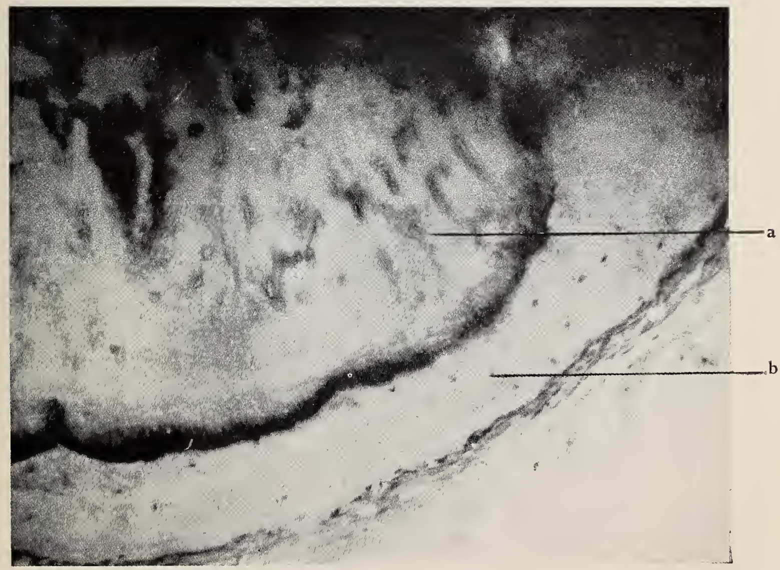


Fig. 4



cementum with living cementum, a side canal containing necrotic tissues, (but now evidently successfully sterilized) being bridged over with living cementum that reaches into the canal. Fig. 4 is a highly magnified view of Fig. 2 which shows more clearly how celless cementum is being covered by living cementum containing celles.

SOCIAL ASPECTS.

The dental world has made up its mind generally, that if we were in a position to denote an incontestable method of root canal treatment, it would of necessity be so pretentious and costly as to be out of reach of a middle class practice, to say nothing of a sick fund practice; this from the beginning robs of success every attempt to find a practicable solution. This so-called "practical viewpoint" calls for some onbservations.

When searching for a solution to a problem, in either Medicine or the Technical Science, it is not permissible to start by first demanding a cheap method that will immediately lend itself for use on the large masses of world population that gain little or no income. First of all we must find a method that guarantees every necessary safety, regardless of cost in time and money. After this is accomplished we can proceed to simplify and cheapen it. This holds good for all the other spheres just as it does for root canal treatment. It is not possible to judge the value of a method on the basis of its adaptability to any certain group of patients. Such a forcible curtailing of research activities must be considered a serious detriment. During the description of our methods we will be able to see how much this applies to root canal treatment. We shall see that the time and energy involved, in the application of the methods, diminishes as the safety of the applied technic increases.

2. THE TREATMENT OF PULPS ACCIDENTALLY EXPOSED.

The pulp chamber may be opened accidentally as a result of trauma or during a cavity preparation. Experience teaches that every attempt at pulp capping has greater chances of failure than pulp extraction. Pulp extraction is therefore the method of preference in all cases where no tangible injury can be caused by it. Only in those cases of youthful patients where the apical foramen is still wide open and where the root has not been completely developed does it pay to attempt a pulp capping and this only to give the root an opportunity for complete development. Even in those cases where the capped pulp is likely to die in the next year or two, the tissues surrounding the apical foramen retain their functions for sometime and this time is a pure gain for the purpose of completing the root development.

The capping of the pulp presents exactly the same problem as the caring for any other section of connective tissue such as is caused by pulp extraction. The exposed pulp is washed with H_2O_2, dentin powder which we always have at hand for the root canal filling mixed with hilisitin, is gently placed to cover the exposed pulp, and then covered with cement containing 2% Trioxymethylene. It is expedient to first apply a drop of phosphoric acid to insure that the cement will seal completely and will also exclude any air bubbles.

In cases where the exposure was caused by a fracture of the crown and there is insufficient hold for sealing with cement, the following procedure should be followed. Open into the pulp chamber with a sterile large round bur, excavating the superficial portion of the pulp, forming a cupshaped concavity in the chamber. Rinse with H_2O_2, and cover the exposed pulp with hilsitin mixed with dentin powder. Remove all fatty traces with benzine and fill with cement, containing 2% Trioxymethylene. Cover the soft cement with a little cement powder in order to hasten the setting. In cases where he root development is already completed it is expedient to extract the pulp immediately after an accidental exposure.

3. THE TECHNIC OF PULP EXTRACTION.

It is surely superflous today to advance proofs that the pulp extraction should be carried out under local anesthesia and not after a preceding chemical devitalization. With a suitable technic of anesthesia we can practically always attain that degree of painlessness which will enable us to extract the pulp without any complaint from the patient. Every devitalizing agent brings in its wake a necrosis of the tissues that evinces itself in an inflammation of their peripheral parts. The use of arsenical preparations is accompanied by a leakage of the arsenic and the storing up of it in the tissues. It is almost impossible to limit the action of devitalizing agents to a given area, and we are dependent upon chance. How often have we observed cases where it was impossible to restore a tooth to comfortable normality after it had been subjected to the constant irritation of a devitalizing agent. I can see no advantage in the use of devitalizing agents, but on the contrary only disadvantages.

TECHNIC OF ANAESTHESIA.

To facilitate the work, we feel that the subsequent few remarks in regard to the technic of anesthesia are in order. For purposes of pulp extraction or cavity preparation anesthesia of the pulp is aimed at. Wherever you inject it is imperative that the tip of the needle come in direct contact with the bone, that means to say, that the injected fluid be deposited as near as possible to the nerves that mostly lie near or in the bone itself. Even if only a thin layer of soft tissues intervene between the bone and the deposit of the anesthetic this already precludes a successful result. By adhering to a suitable technic of injection, a 2% solution will satisfy all needs, although there is no harm in using a 4% solution. It is advisable to rely more upon a proper technic rather than a higher concentration of the anesthetic fluid.

If we intend to anesthetize in the region of the eight anterior teeth, it is expedient to puncture the gum tissue in the vicinity of the apex of the tooth in question, making certain that the tip of the needle is in contact with the bone; now with the forefinger of the free hand massage slowly at that point while injecting and continue to massage for a little while after completing the injection. This massage has for its purpose the driving of the fluid through the small openings of the bone into its depth, thereby shortening the wait for the effective stage.

The method of choice for the upper molars is the tuberosity injection, while for the lower jaw conductive anesthesia at the mandibular foramen is preferred. The customary instruction to use long needles for these two forms of anesthesia should be labeled as inexpedient. Many a failure in these two forms of anesthesia can be traced to the use of the long needle. It is generally advisable never to use the long needle, a short needle of about 20 mm. length being ideal for all forms of injection.

In the tuberosity anesthesia puncture the gum in the region of the apex of the distal root of the first molar, keep the tip of the needle in constant contact with the bone and press it forward while emptying the syringe to the rear. In the mandible palpate carefully for the internal oblique line, puncture the gum at this point, advance the syringe a trifle, and do not empty the syringe until you make absolutely certain that the tip of the needle is in contact with bone. At this point the syringe should not be pointing upwards, for then the tip of the needle would not be on a suitable level. (Fig. 5.) If you adhere to these hints, you can apply the rubber dam directly after the injection and begin to work. The full effect of the anesthetic should be obtained in a few minutes.

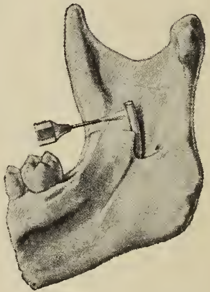


Fig. 5. The tip of the injection needle has travelled very little beyond the internal oblique line, lies close to the bone and empties its contents directly against the nerve.

RUBBER DAM:

Root canal treatment should be undertaken under rubber dam only. Every argument to the contrary has long since been ruled out regardless of its origin. The single hole rubber dam punch should be used, a large punched hole being suitable for all teeth. If a clamp is to be used, use one with dam-engaging projections only and fit it into the rubber-dam as in Fig. 6.

The clamps illustrated in Fig. 6a are constructed to correspond to the anatomic cross section of the teeth in question, so that they fit accurately to the neck of the tooth whose mark they bear.

In case you wish to apply the rubber-dam to several teeth, apply a lubricant to the rubber dam bridges between the individual holes, thus facilitating their passage through the contact points.

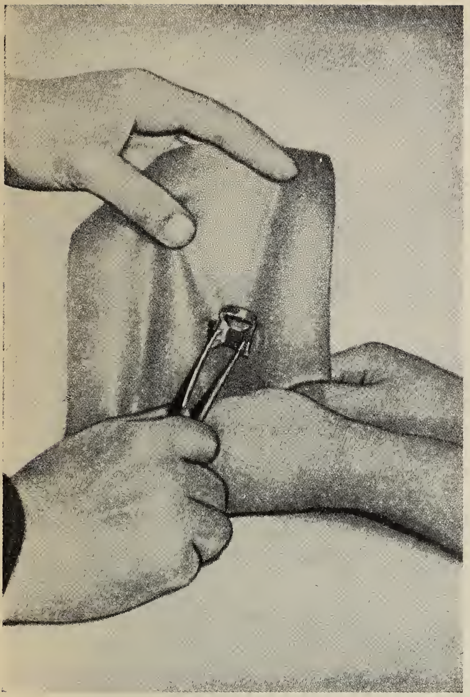


Fig. 6. Position of clamp in applying the rubber-dam.

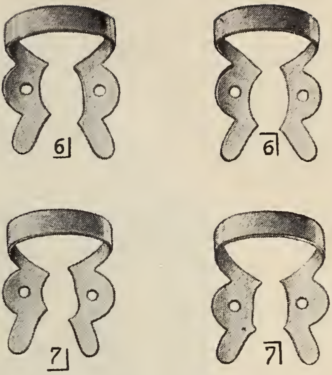


Fig. 6a. Anatomically constructed rubber-dam clamps.

TREPANNING:

During pulp extraction on anterior teeth, one often sees the mistake made of opening into the chamber too near the gingival margin, instead of planning it so that it will be a direct extension of the root canal. In the first place, this sometimes necessitates the bending of the broaches, which is undesirable for various reasons; in addition, the coronal horn of the pulp remains unexcavated and easily effects a discolouration of the crown. In opening molars it sometimes occurs that one drills straight through the floor of the pulp chamber, and wonders how he could have been guilty of a perforation at the bifurcation without having noticed that he was in the pulp chamber. The explanation is that as a result of many operative procedures, secondary dentin and denticles have formed and the pulp chamber is in this way almost entirely obliterated. Such unpleasant occurences can be avoided by making it a rule when opening lower molars to do so in the general direction of the distal canal, and in the case of upper molars to be guided by the palatinal canal. Having reached these canals, it is only a matter of cautious procedure to open the rest of the chamber. During the opening it is expedient to continually wash out and dry the cavity in order to expose to view the sulci between the denticles and the walls of the tooth, and thus be enabled to distinguish one from the other. Then, with a little care, the denticles may be released altogether and removed, with a resulting clearer survey. Fig. 7 illustrates a section of a first molar, where the pulp chamber is completely filled in by denticles.

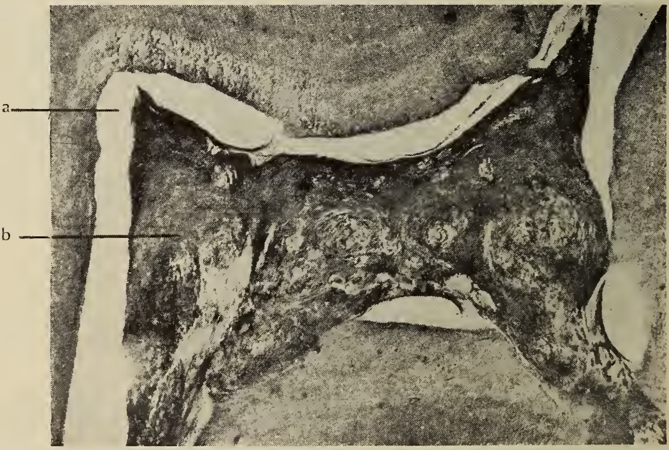


Fig. 7. Lower first molar, whose pulp-chamber is filled in with denticles (b). (a) sulcus caused by artificial shrinkage.

TECHNIC OF PULPEXTRACTION:

If there is need to grind through the enamel, this should be done before applying the rubber-dam; after applying the rubber-dam the teeth should be painted with tincture of iodine and from thereon the work should be carried on with as complete sterility as is possible. For this purpose, it is absolutely necessary to prepare sterilized burs and broaches that are to be used in extracting the pulp and widening the canals. The burs should be kept in a container divided into compartments (Fig. 8) from time to time sterilized in a hot-air sterilizer so that they are ready for use at all times. The nerve extactors (broaches) and Kerr filles are best kept in a glass container (Fig. 9), which is fitted with a stand. The broahces and files are arranged according to sizes.

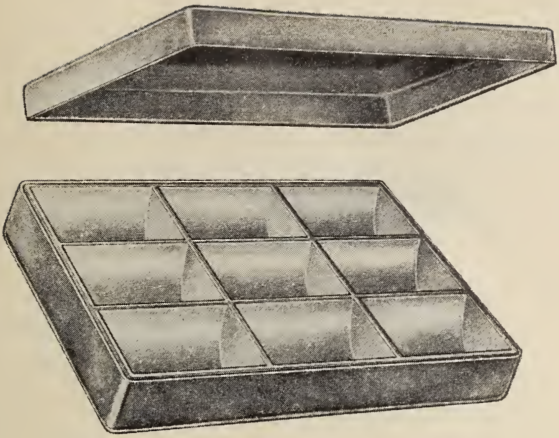


Fig. 8. Container divided into compartments for various sorts of burs; this enables having a supply of sterile burs constantly at hand.

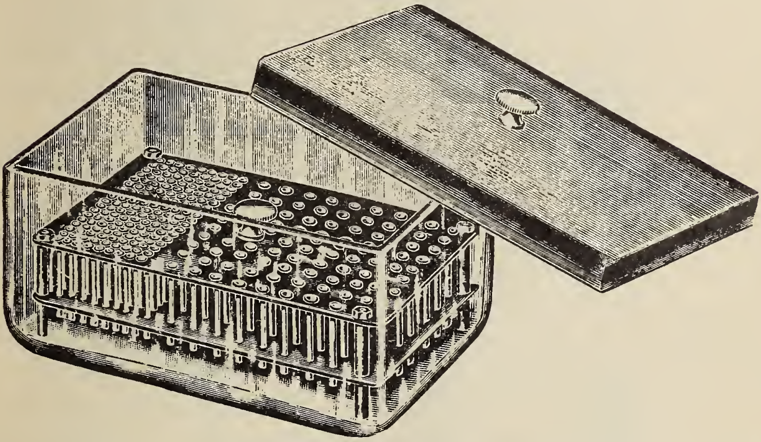


Fig. 9. Container for retention of Kerr files and nerve broaches, which container is filled with spirit of soap.

The glass container is filled with a solution of soap in spirit, and the broaches and files are continually immersed in the solution. A mechanical cleaning of each broach or file after use and replacing in its corresponding tube is sufficient, as several hours immersion in the spirit of soap solution guarantees complete sterility. The container must be cleaned thoroughly and the solution changed once a week. We recommend to have two such containers, one for use during pulp extraction, and one for use in treating infected root canals.

After opening the pulp chamber with a rose-bur and suitably shaping the opening with a fissure-bur, so as to leave no undercuts, probe the canal with a No. 1 Kerr broach, mounted in a holder to ascertain if entry is easily managed. The holder for Kerr files pictured in Fig. 10 has three grooves, so that the files can be mounted at three different angles; the oblique angle will be used mainly and the right angle will be very handy for mesial canals of molars. The possibility of mounting the file in direct line with the holder will be of least use. Now inject 3% hydrogen peroxide solution into the pulp cavity and extract the pulp. Broaches with long handles are dispensable; it is quite sufficient to stock up on broaches with short grips only. In the use of broaches as well as the files observe the strict rule of using light pressure only in turning them. The revolving of the broaches and files should be made very gently, otherwise the danger of breaking them off is enhanced. After extracting the pulp, the canals are progressively enlarged with the files up to No. 5, remembering under no condition to pass on to a larger size before you have established the free entry and exit of the lower sized file. The use of the hydrogen peroxide is kept up during the entire procedure. It is advisable to prepare two holders, fitted with two different files to enable more rational work. If at the end of the pulp canal you find yourself on solid tissue and no doubt exists that you cannot reach beyond that point, and you are sure that you have not passed through the apical foramen, then radiological control is unnecessary. In doubtful cases it is advised to take an X-ray photograph with size 2 file in position in the canal as far as it will go; this will show how far into the canal the end of the file has progressed, and by measuring the distance on the file you can determine the length of the root canal, thus

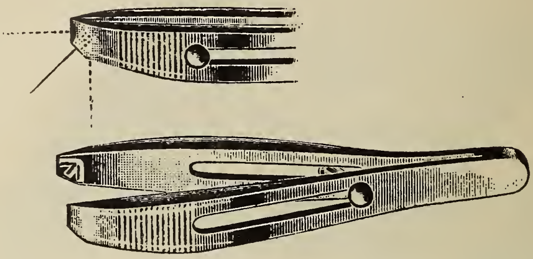


Fig. 10. A Kerr file holder, notched to enable the files to be mounted at three different angles.

insuring that the root canal filling be not driven beyond the apical foramen. In extracting a healthy pulp, under no condition are you expected to force your way up to the apex. Should you find obstacles, do not attempt force, nor should you drill through, but respect the obstacle and limit your activities up to this point. Having widened the canal up to file No. 5 (in narrow canals No. 4 suffices), it is now ready for irrigation and drainage with the Seidner apparatus.

DRAINAGE OF CANALS BY SUCTION WITH SEIDNER APPARATUS:

As a rule the two one holed rubber stoppers pictured in Fig. 11 suffice, (namely the pointed and cup shaped). In cases of irregul-

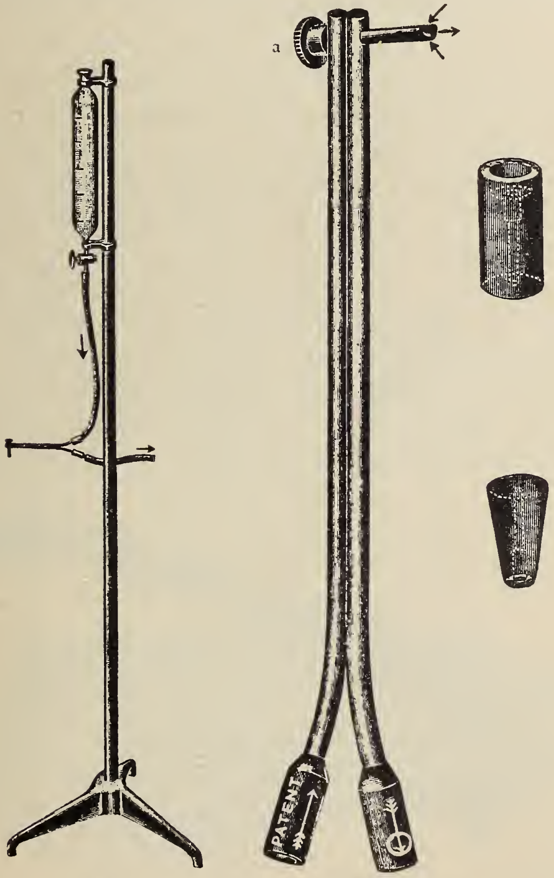


Fig. 11. Seidner drainage and flushing apparatus with two rubber attachments, for purpose of sealing air-tight; (a) is head screw, which can be dismantelled for cleaning.

arly formed cavities, the cavity margins must be filled out with guttapercha, to form an air tight joint with the rubber attachment. The power for suction is supplied by a water suction pump. In some places water pressure is low, the faucet at the wash basin would serve for attachment of the water suction pump, as the pressure at the fountain caspidor attached to the chair would be too low. There are electric suction pumps as well, that are recommended for this purpose, and there are also foot driven pumps for those colleagues who must economize. Years ago I constructed a special suction arrangement attached to the dental chair. The attachment is made to the main water pipe and serves for the Seidner suction appartus as well as for suction tubes, used during surgical operations. Should the suction power prove insufficient at any time, make sure that the tiny openings of the apparatus are not clogged. Generally it is sufficient to stop the stream of the water suction pump at its outflow, forcing the current through the apparatus, thus cleaning it out. When the influx is blocked and the corresponding rubber tube does not contract quite flat, it is an indication that the suction power has an obstacle to overcome, or hat the joint is not air-tight. Sometimes it is necessary to remove the head screw (a in Fig. 11) and clean the thin tubes with a Miller broach. It is expedient from time to time to clamp the conveying rubber tube close to the apparatus, as pictured in Fig. 12, since in doing so you raise the suction action in the canal. Experiments have showed that only by this clamping is it possible to drain a narrow canal of its fluid, otherwise the suction has no effect on such fluid. In

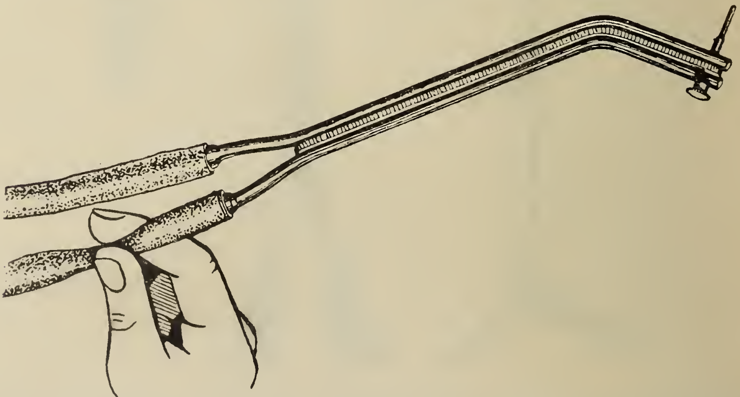


Fig. 12. Clamping of the conveying pipe with a resultant increase in suction power.

clamping the tube several times and allowing the hydrogen peroxide to flow through, you have really cleaned the canal.

If, especially in case of infected apical areas, one wishes to be sure that the suction power reaches beyond the apical foramen, then he should follow the advice of Dr. Seidner, and attach a needle that reaches to a vicinity of the apical foramen (Fig. 13) and extends the suction power to that point with certainty.

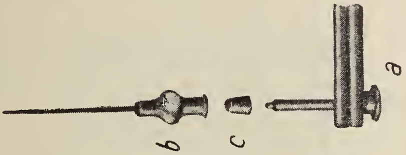


Fig. 13. A needle b mounted on to the Seidner apparatus by means of a connection c which transfers the opening of the suction near to the apical foramen and increases the effect of the suction.

Drainage after pulp extraction has proved quite benefical for the reason that after the widening of the canals, tissue shreds still remained therein or in niches, which are gathered up and removed by suction. Therefore drainage by suction after pulp extraction should not be neglected.

ROOT CANAL FILLING.

If no hemorrhage of any account ensues then the root canal filling can take place in the same sitting. If a hemorrhage is present, and one wishes to be doubly careful it is expedient to postpone the filling for another visit. For filling at the first sitting, dry the canal with sterile paper points. The glass tubes for the various sized points are kept on a stand in a glass container (Fig. 14) with tightly fitting cover, and on whose floor a piece of cotton saturated with formalin is placed. After drying

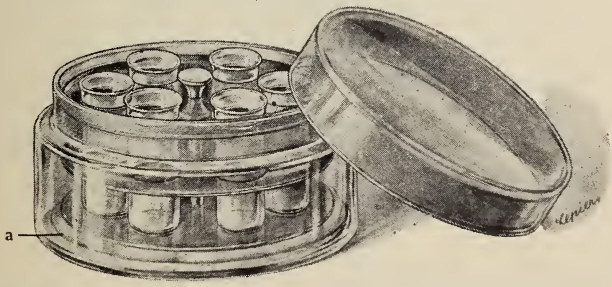


Fig. 14. The paper points are kept in a stand under which lies cotton saturated with formalin a.

the canal thoroughly, squeeze some hilsitin salve *) out of the tube on to the end of the lentulo spiral dip it into the dentin powder (Fig. 21) and rotate it into the canal on to the exposed surface of the pulp stump, having first measured off on the lentulo spiral (the right angle one suffices) the distance according to the measure taken of the canal with the Kerr file (Fig. 15) so that you know how far in you need to go. Remove all fatty traces from the canal walls by means of cotton wound on Miller broaches dipped in benzine. If using paper points make sure to cut off the sharp points so that the squared off end will act as a plugger condensing the salve dressing. Moisten the walls of the canal with cement liquid (phosphoric acid) by means of a paper point. Remove all traces of the hilsitin from the end of the lentulo spiral, with benzine, and

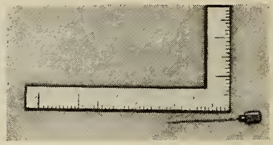


Fig. 15. Measuring the length of the file radiographed within the canal with the scale to establish the length of the canal.

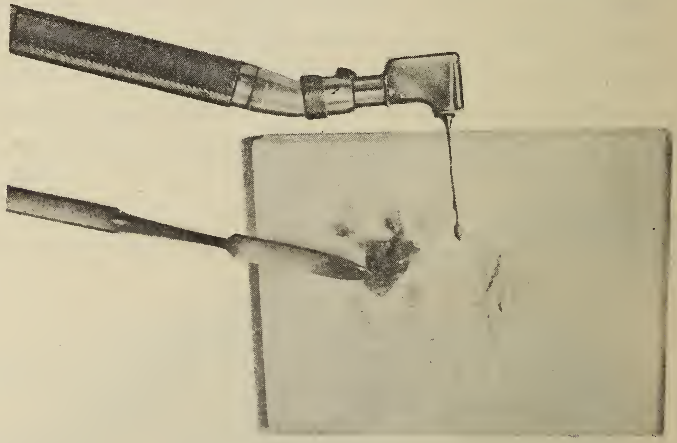


Fig. 16. Taking up the cement for filling the root canal on the lentulo spiral, prior to rotating it into the canal.

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*) The hilsitin salve has proved itself to be best means after numerous experiments with other woundsalves. It is a salve for burns and wounds that is employed to great advantage in skin affections.

after mixing cement with 2% trioxymethylene take it up with the spiral (Fig. 16) and rotate in into the canal up to the mark mentioned above. A guttapercha point (kept in a container Fig. 17) of a length according to the previous measure is pressed home,

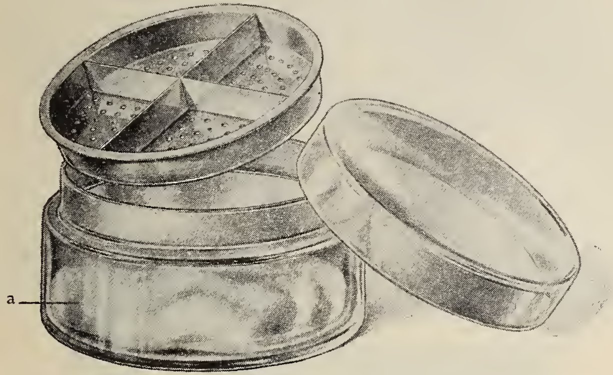

Fig. 17. Container for guttapercha points, with cotton saturated with formalin a.

followed by a thicker point. The surplus of the guttapercha points is removed with a heated instrument and the filling is covered with harder cement.

Having decided to fill the root canals at the next sitting, we close the opening to the canal with cotton and the cavity is sealed with a temporary cement. At the next sitting, which may take place one or several days later, rubber-dam is applied, cotton removed, and fill as described.

PRODUCTION OF DENTIN POWDER.

The producion of dentin powder takes place as follows. All teeth extracted with vital pulps for whatever reason are cleared of all soft layers by scraping and placed in a bottle containing a 10% formalin solution. In your leisure time, take out one of these teeth and grind away the enamel with a carborundum stone (Fig. 18). Now take a sterile bur and remove the dentin from crown and root as far as you can over a Petri dish (Fig. 19). The dentin powder is kept in a container provided with a bit of cotton saturated with formalin on its floor, while the dentin dish is suspended above it. The flat edges of this metal inset are provided with holes to allow the formalin fumes to penetrate to the dentin, while the dentin powder itself is placed in a concavity (Fig. 20).

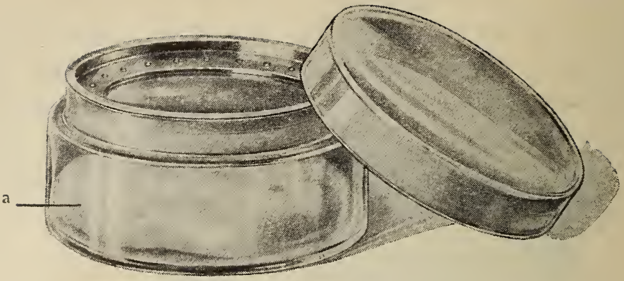

Fig. 20. The dentin powder is kept in a metal dish within a glass container; under this dish cotton a, saturated with formalin is placed. The rim of the metal dish is provided with a series of small holes to enable the formalin fumes to reach the dentin powder.

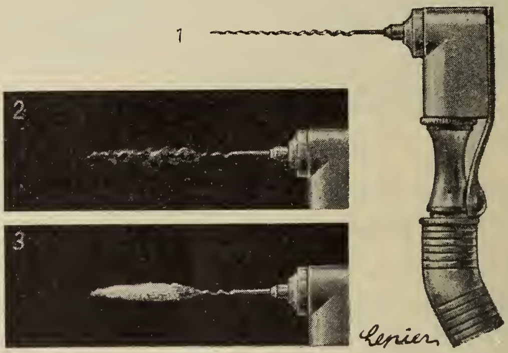

Fig. 21. The lentulo spiral (1) takes up some paste (2) first, and this paste in turn is dipped into the dentin powder, so that it is covered with a cap of dentin powder (3).

4. PULPITIS.

We cannot adopt a general behaviour towards a tooth suffering with pulpitis, as this complaint presents various graduations. If the infection has just reached the pulp, then the spontaneous pains begin; sensitiveness to cold sets in. This condition can be

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Fig. 18. Grinding away the enamel a on an extracted tooth,, to expose the dentin for drilling out. The tooth has just been removed from formalin and is held in a sterile napkin.

Fig. 19. The dentin is being excavated and the dentin powder is caught up in a Petri dish.

Fig. 23. (1) shows a large periapical involvement on a tooth before treatment. This was treated in 1927. (2) shows the file within the canal for measuring its length. (3) directly after the root canal filling. The resorbed area contains a fatty substance used in the treatment which is radiopaque. (4) is a control picture taken in 1930.. The involved area has regenerated entirely and (5), which was taken for control in 1938, shows an equally favourable condition.

Fig. 18

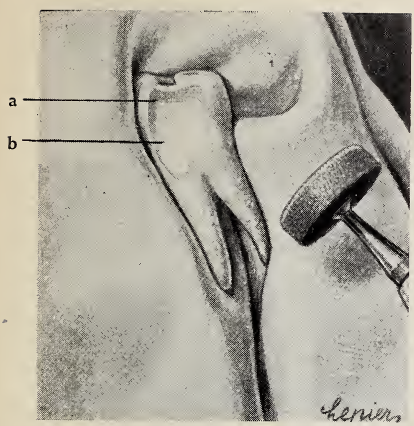


Fig. 19

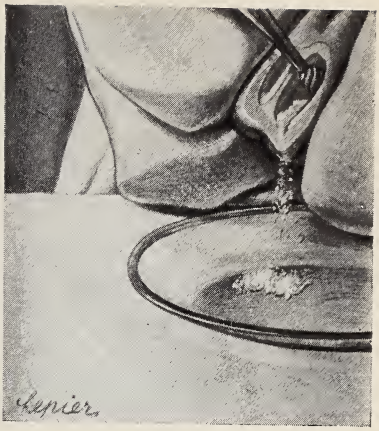
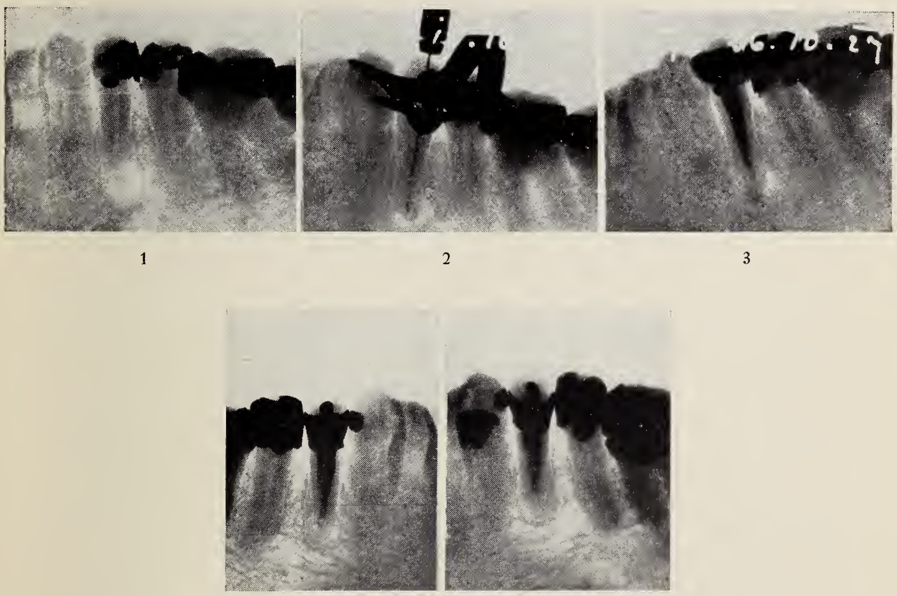


Fig. 23



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treated as a pulp extraction, as we may assume that the infection of the pulp is of very recent origin. When time does not permit the extraction of the pulp immediately, a pellet of cotton dipped in camphorphenique is placed over the pulp and sealed with temporary cement which alleviates the pains. The pulp extraction can then take place at a more convenient date.

Should the patient fail to report for treatment at this early stage, then a progressive deeper and deeper decay of the pulp sets in, and in time the inflammation reaches beyond the apical foramen, a fact that can be identified by an approaching sensitiveness upon heat and percussion. Such a case we must treat as gangrene.

5. TREATMENT OF INFECTED ROOT CANALS.

RADIOLOGICAL CONTROL:

A complete radiological examination of the mouth from time to time may appear as superfluous in many cases; it has, however, often led to discovery of unforseen surprises, and it must be labelled as expedient. Periapical processes and similar, not to be underestimated changes, are not always the cause for definitely localised complaints.

JUDGING OF CHANCES FOR RETENTION:

Before one undertakes to treat an infected root canal and its frequent apical involvement, he should decide whether or not the retention of the tooth in question is worthy of attempt. To formulate hard and fast rules to govern this question is certainly inexpedient. For instance, we will decide the fate of an infected root canal in the case of a healthy person differently from a similar condition in a person that suffers from some general complaints. In the former case our decision will lean towards treatment, while in the latter we are more likely to favour extraction. The extent of bone resorption will also have to play an important role in our decision. Having decided to retain the tooth, we must adhere to a definite method of treatment. The following is a description of a method of treatment, that has stood the clinical tests excellently, and, what carries the most weight, it has netted the best results in the experimental treatment of the dog.

GRINDING AWAY THE REMAINS OF CROWN.

Wherever possible, the remains of the crown, and mostly it is a case of such a tooth only, should be ground down *) so as to leave a stump beyond the gum line merely, sufficient to serve as a hold for the rubber-dam. For cosmetic reasons we may except the anterior teeth, but not the bicuspids and molars. Our work is extraordinarly facilitated thereby, and the possibility of attaining a favourable result is enhanced disproportionately. In most cases the loss of the remains of the crown cannot actually be considered a loss.

MAKING THE PULP CHAMBER AIR-TIGHT FOR SUCTION.

In making our preparation we must keep in mind that the pulpolyt and the iodine for the ionization must be applied properly to the canal opening without the fluids leaking into the mouth. Often enough you will find here and there on the reduced stump, that the margin of the pulp chamber lie deeper than the reducing of the stump allowed us to grind, which circumstance spells a direct disadvantage in regards to the above mentioned necessary precaution. In such cases it is expedient to fit a low cut copper ring over the stump, barely allowing the margin of this ring to extent beyond the cross section of the stump; after careful drying of the inside of ring and stump, fill out all discrepancies between them with sticky wax, making a sealed joint between them. The proper anatomicaly formed clamp is then applied over this ring, and the work is than carried on in a sealed cup. After applying the clamp make sure that you have not fractured the sticky wax, which would provide a leakage. In the event of this happening repair this leakage with a heated spatula.

TECHNIC OF TREATMENT.

The openings of the canals should be well defined by pointed fissure burs, so that they should be easily found with a sharp explorer. If the X-Ray photograph discloses a curved root, it is advisable that the broach, mounted in the holder, be curved in the similar direction, and be sure to do so before you attempt to enter the canal for the first time (Fig. 22). The curved broach then glides in and follows the curvature of the root. If care is taken to provide the same curvature to the various sized files,

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*) Proposed by Pichler, Vienna.

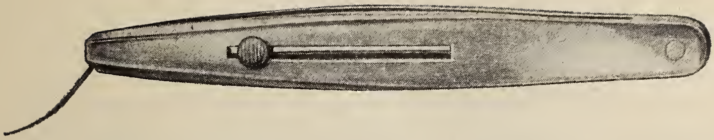

Fig. 22. A file bent in the same curvature as the bend in the root, with which the bend can be gotten around.

unbelievable conditions in the canal can be overcome. Neglect to do this, and the formation of even the smallest false indent at the point of the bend with a sraight broach, makes it very difficult to gain an entrance into the canal beyond the bend, as the point of the broach is constantly imprisoned in the false indent.

The canals are now cleaned with pulpalyt. It is a fluid solvent of organic substance, with a high chlorine content, that, with the aid of the file, brings all the debris to the surface. By means of pellets of cotton keep drying up the pulp chamber of the unclean fluid and replace it with fresh fluid, until the pulpalyt remains unsullied. When you reach file No. 2 approximatelly, leave it in the canal as far in as it will go, take an X-Ray photograph, and note where the tip reaches to. By measuring you can judge the distance between the cross-section of the stump and the root apex, and record it (Fig. 15). This measurement tells you how far you may enter with the files and the Lentulo spiral, as well as how long the guttapercha point should be. Generally it is sufficient to clean up to file No. 5, when the suction apparatus is applied.

As already described, the canal is drained and flushed with the Seidner suction and flushing apparatus with a 3% hydrogen peroxide solution, not forgetting to clamp and release the conveying pipe from time to time to enable the suction power to function over the entire canal. Drain and fllush the canal until the flluid coming out of the canal is quite clear, and pour an aqueous solution of iodine (hilsojod) into the empted glass container, of the Seidner apparatus; this is done to replace the hydrogen perxide in the canal with this iodine solution, and thus create a favourable transition for the ionization iodine.

After this the chamber and canals are dried out, excess fluid removed, a paper point is placed in the canal and ionization iodine (zinc iodine 15 gr. pure iodine 5 gr., and distilled water up to 50 gr.) is introduced into the pulp chamber. The paper point is moved to and fro in the canal several times, and removed, that we are assured that the iodine will flow easily into the canal. Now with the aid of a heated copper wire (Fig. 24) bring the iodine in the canal to a boil three times. It appears that by this process the iodine whizzes into the side canals, and thus enables the current to reach even there partly.

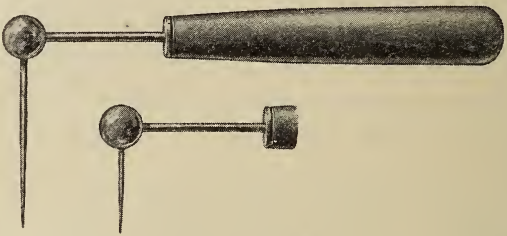

Fig. 24. Copper wire in two lengths to be used in shorter and longer canals for heating up the ionization iodine.

IONIZATION.

Now the ionization apparatus (Fig. 25) is so applied that the negative electrode comes in contact with the iodine in pulp chamber while the positive electrode is held in both hands*). The negative electrode should be held firmly in position and for this purpose we have constructed a useful device in the form of a forehead attachment. Thus the following is effected that the iodine ions are transported towards the periphery lugging along iodine molecules and act upon the root apex and its surroundings. The iodine is particularly suitable for this purpose because, in contradistinction to the formalin preparations, it unites with the albumen decomposition products of the tissues and the microorganisms to form irreversible compounds of iodine and albumen, that are nonpoinsonous. This ionization, therefore, brings about a removal of the poison from the infected area.

The illustrated ionization apparatus is especially recommended on account of two features: firstly a "U" shaped tube (a) is attached to this apparatus, which has a graduated scale and contains a sour water (it can be stained). When the stopclock is shut, the hydrogen gas developed compresses the fluid, and the scale is adjusted according to milliampere minutes, so that at any time the operator may read on the scale the number of milliampere minutes effected (Coulombmeter). The more milliamperes the patient is able to tolerate, the less time must be spent in ionization. As a rule the milliampermeter may be advanced after a few minutes, so that more and more milliamperes may be applied. The patient signifies from time to time the limit of his tolerance. From time to time make sure that the iodine liquid has not been used up or lost its coloration, and always add fresh liquid. In the case of singlerooted teeth it has proved expedient to use at least 50 milliampere minutes; in the case of the latter put also electrode in the pulp chamber. The number of miliampere minutes will also depend upon the size of the infected area as well as the facility of passage through the canals; the larger the area the more the milliampere minutes applied. In the treatment of an infected canal that shows no involved area radiologically, and which is very difficult of passage, we will also apply a greater number of milliamper-minutes, out of consideration for the probability that in the narrow canals the iodine ions will make very slow headway.

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*) According to Bernard, Paris.

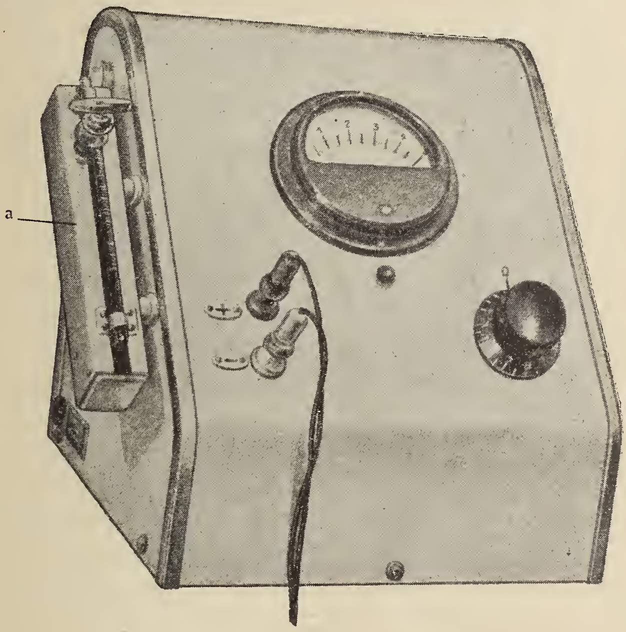

Fig. 25. Ionization apparatus with its graduated tube (a) filled with coloured phosphoric acid, for denoting the number of milliampere-minutes. The electrode for inserting in the tooth warms up the ionization iodine.

Another advantage of this apparatus, is the provision for the heating of the tooth-electrode, whereby the ionization is furthered*). Control allways the heat of the electrode with your finger.

After completing the ionization put a pellet of cotton into the pulp chamber and seal with a temporary filling; after 24 hours, you will stil find a brownish coloration of the walls of the tooth; should you leave the cavity sealed for several days you will find the walls absolutely colorless; a proof that the supply of iodine was completely consumed by the union that set in. We need take no precautions against possible appearance of pain after this sitting. It may be considered a rule, that no pains appear. This happy state is due to the drainage by suction on the one hand, and to the ionization on the other. Through drainage and rinsing we have removed as far as possible the canal contents and by ionization we have removed the poisons from the entire area to a great degree. After the ionization it is expedient to allow a few days to lapse before beginning the second treatment. On the contrary it is most inexpedient to apportion the measures described for he first sitting, and to divide them up into several sittings. The pleasant effect of the ionization for assuring an absence of pain should take place in the first sitting, otherwise we must always expect pains to appear. No alarm should be felt by the patient or the dentist if within 24 hours a marked swelling and pus formation over the treated area is observed. This is rather a good sign and a proof that the transformation from a chronic to an acute condition has been successfully accomplished. Merely lance and allow the pus to flow out.

SECOND SITTING.

In the second sitting we again apply the rubber dam. If you used a copper ring it should still be in position; make sure that the sticky wax still seals it air-tight and if not correct all leakages. Now drain with the apparatus taking special notice whether or not any exudate appears with drainage. The extent of the resorbed area shown on the radiogram must be taken into account. At this point it must be decided when the root canal filling will take place. There are no hard rules to govern this decision; it is made possible only through experience. Let us assume the worst case. In that case, after the drainage by suction we dry the canal, until the paper points come out quite dry, we measure off on the lentule spiral the distance recorded for the canal length in the first sitting. Now we squeeze some pulpaste out of the tube onto the lentulo spiral and rotate it into the canal up to the apical foramen. Pulpaste is a eugenol paste.

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*) The construction of these improvements is done by E. Kellner, Haifa.

ACTIONS OF EUGENOL AND FORMALIN PREPARATIONS.

We all know, that for almost the last hundred years, eugenol and the various formalin preparations have given a good account of themselves in the practice of dentistry. This fact alone should teach us that their effect must have met with satisfactory clinical results, as otherwise it were illogical for them to persist so stubbornly on our pharmaceutical lists. Up to date no one has tried to explain the efficiency of these two drugs. The following appears best to explain it; both drugs have a market reducing effect. Every reducing effect signifies a check on inflammation, combate the cellular infiltration, and the exudation and promotes the formation of a tissue poor in cells. In connective tissue this is known as promotion of cicatrisation and in epithelial tissues it is called promotion of hornification. In the first sitting of the gangrene treatment, we furthered the oxydation by means of the chlorine containing pulpalyt and the ionization iodine, kindling into life the processes of inflammation some time ahead of schedule, while in the second sitting we begin to combat the inflammation, assist it to recede, and to promote the formation of cictricial tissue. This is the sense of the eugenol effect in the pulpaste.

Clinical experience teaches us that we combat the formation of an exudate with remarkable success by means of the eugenol paste. It is advisable to leave the paste in for several days up to a week, and in the case of a marked exudation to drain by suction and repeat the treatment with a fresh paste. The long effect of this paste is urgently necessary to absolutely assure the non-reappearance of exudation, otherwise we must reckon with a resetting in of exudation as soon as the eugenol effect ceases. When draining a canal of paste by suction we must make use of a warm rinsing fluid. The fatty contents of this paste has a very low melting point, remains in a fluid state in warm water at 60° C., and in this form can easily be removed by suction.

FINAL SITTING:

If in our opinion the canal is ready for filling, then, we place the Hilsitin-dentin powder, mentioned above, over the apical foramen by means of a lentulo spiral; the fatty contents are removed from the walls of the canal by means of benzine, and the root canal filling follows as described in the extraction of the pulp.

In cases of ossification, where the apical foramen was inaccessible, and the radiological findings of the periapical space is reassuring, we can fill the root canal at the second sitting after the drainage by suction with cement and guttapercha points, without the addition of the dentin powder, as in this case the filling does not come in contact with the connective tissues.

In fig. 23 we see an infected tooth treated in 1927 and radiologically crontroled up to 1938.

6. EXTRACTION OF INFECTED TEETH.

TECHNIC OF TOOTH EXTRACTION.

Post extraction pains are as a rule the result of a crushing of either the soft parts or the bone, so that an infection of these necrotic tissues sets in, accompanied by an inflammation, which should cause the elimination of the injured tissues. This may occur in the case of teeth with vital pulps as well as in teeth with infected canals. Also for some reason the secondary haemorrhage upon the alveolar bone may fail to appear, the bone is thus exposed to the infection and developes an osteitis (dry socket). In the case of infected teeth a part of the necrotic granuloma may also remain behind on the floor of the alveolus, causing a perceptible or imperceptible injury. We therefore recommend the use of the surgical suction tube (Fig. 26) for draining the alve-

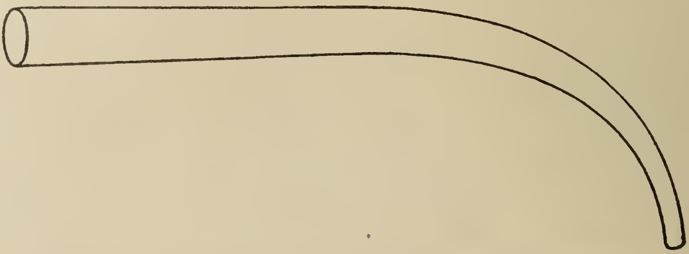

Fig. 26. A metal suction tube for draining blood and fluid.

olus a measure that has given an excellent account of itself In infected teeth we recommend particularly repeated syringing of the alveolus with an aqueous solution of iodine (hilsojod), at the same time cureting gently the floor of the alveolus with a small sharp curet (Fig. 27) and continuing to syringe and drain to make sure that all necrotic tissues as well as all possible tooth or bone splinters are removed. If the crests of the alveolar process are too high, it is advisable to remove them with a bone forceps (Fig. 28) or with chisel and mallet, in order to enable the gingival margins to close up over the wound, unite with the blood clot and thus form a suitable covering for the wound.

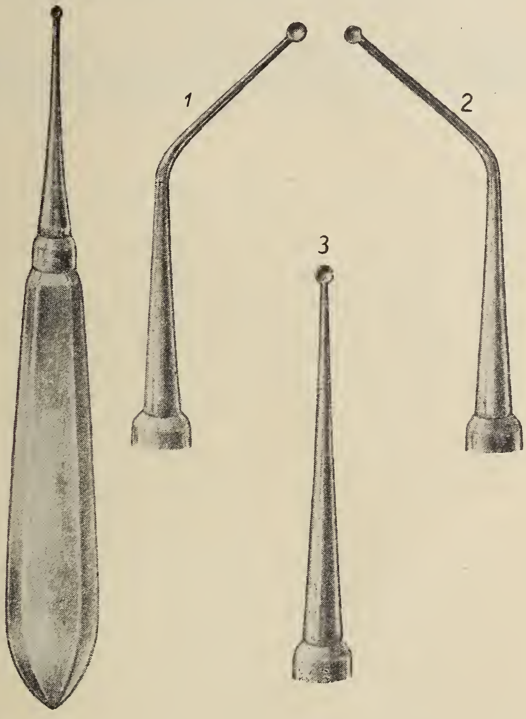

Fig. 27. Curettes, (1) and (2) curved, (3) straight for curetage of socket floor after extration of infected teeth, not forgetting to rince with hilsojod at the same time and drain with suction tube.

It is wise to loosen every tooth that sits halfway tightly in the alveolus by means of an elevator (Fig. 29) or a straight chisel and a mallet, which is applied to the periphery of the tooth at consecutive places.

Particulary, in the case of upper molars, the roots are arranged

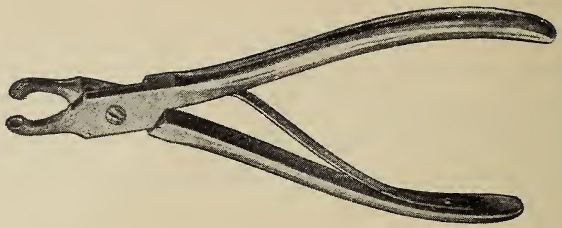

Fig. 28. Bone forceps, for removing and smoothening the crests of the alveolus.

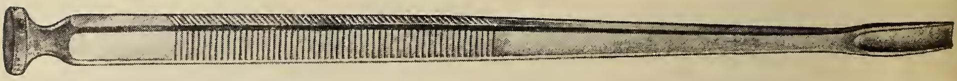

Fig. 29. Elevator for loosening a tooth prior to extraction.

so divergingly, that a circumference drawn through their apices is considerably larger than the circumference of their entrance into the alveolus. In these cases if an attempt is made to extract the tooth, the root apices are pressed with considerable force against the wall of the bone. This is inexpedient even in the extraction of a tooth with a vital pulp, as this injures the bone, and as already explained results in post extraction pains. If in addition we are dealing with a tooth with an infected canal, the forcible grazing of the infected root apex against the walls of the bone is certain to produce an infection of these walls. One should not be surprised at an osteitis as a result of this practice. Make it a rule therefore, to grind every multirooted tooth destined for extraction down to the gum margins then separate between the individual roots with carborundum separating disks and fissure burs make certain that the separation is complete by inserting a straight chisel between the individual roots and elevating them. Then each root is extracted individually, with the least possible scraping of the root apex against the bone wall.

PRESERVATION OF SURGICAL INSTUMENTS.

I take this opportunity to recommend most warmly the keeping of the surgical instruments in glass or metal tubes, as can be seen in fig. 30. In the case of metal tubes, you should engrave some sign according to convention, on the base and cover, such as the initials of the instruments contained therein. This will inform you what instrument you may expect to find in the tube.

Now we make a practice of executing the sign in large upon the cover and in small upon the base of the metal tube; this prevents the parts being mixed up when opening a number of tubes at the same time. We found it unusually expedient to sterilize the instruments after use and keep them prepared in

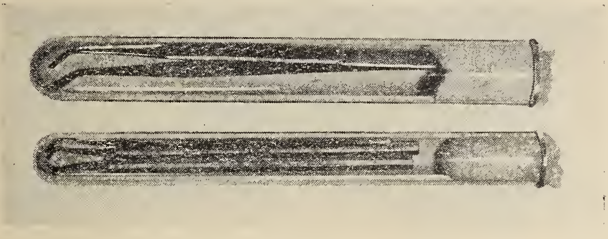

Fig. 30. Instruments sealed in tubes. The tubes with their contents are sterilized in the hot-air sterilizer and are then kept sterile and ready for instant use.

a sterile condition instead of sterilizing them before each operation. It is advantageous to have your entire instrumentarium ready for immediate use, thus avoiding embarassment and confusion when a sudden need crops up for this or that instrument in any operative procedure.

7. FOCAL INFECTION AND PYORRHEA.

If one makes it a practice to maintain the gingiva in a good healthy condition in every patient he is not likely to experience any surprises. The presence of bridge-work in the mouth makes it especially advisable to make a full mouth radiological examination from time to time, as already mentioned. You may sometimes find a newly formed pocket, or an extruded root hanging on to the bridge (Fig. 31). It has already been mentioned in its proper place that such a root may be severed from its attachment without endangering the safety of the bridge.

In upper molars, you will sometimes find that one of the roots, in most cases the oral one is almost completely extruded while the two remaining ones are still firmly embedded in the jaw. You may safely proceed with the pulp extraction in the two firm roots. After completing the filling, the extruded root can be severed from the tooth by means of a fissure bur slantingly towards the occulusal surface, and thus retain the functional usefulness of the tooth for some time. It is expedient to exarti-aculate the tooth in question in order to lighten its functional burden.

8. CYSTS

In a certain sense the formation of a cyst signifies a selfcure, in as much as the connective tissue is separated from the focus of infection by means of a partition wall of epithelium. In many cases this healing is incomplete, and you may find here and there in the vicinity of the epithelium foci of inflammation. Frequently the cysts are filled in with a fluid, containing cholesterin crystals (Fig. 32).

In the region of the antrum there is always the posibility of a periapical infection breaking through into the sinus and thus lead to a sinusitis. Fig. 33 shows us a fistular canal leading from an apical cyst into the sinus. In connection with such a communication we may find a covering of the cyst with ciliated epithelium originating from the epithelium of the antrum (Fig. 34).

We know, that cysts sometimes displace the entire sinus. Fig. 35 shows us a cyst, belonging to an extracted tooth, whose extent may be judged by comparison with existing teeth in the same illustration.

The cyst evidently owed its existence to a continuous infiltrating of fluid through the epithelium into the cavity, without having a discharge opening at its disposal. The pressure within the cyst becomes greater than the tissue tension, and this enables the cyst to expand at the expense of the surrounding tissues. We

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Fig. 31. Excision of extruded roots from under a bridge, while the bridge remains intact.

Fig. 32. Root apex with a cyst, which is lintd with epithelium (a). Chlorestin crystals within the cyst cavity.

Fig. 33. A periapical involvement on an upper 2nd bicuspid with a fistular opening (a) into the adjoining aantrum (b). Building of bone (c) and (d) to correspond with the wall of the periapical cyst.

iFg. 34. A periapical abscess at the root apex of an upper molar. The abscess is lined with columnar epithelium (a).

Fig. 35. Upper 2nd bicuspid has been extracted, (a) place of extraction, (b) an especially large cyst. The two remaining teeth appear particularly small in comparison with the large area occupied by the cyst.

Fig. 36. A periapical involvement rich in epithelium (a). The cyst is in a state of inflammatory retrogression, so that osteophytic bone (b) has developed along its wall.

Fig. 31

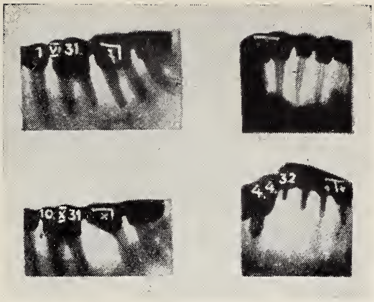


Fig. 34

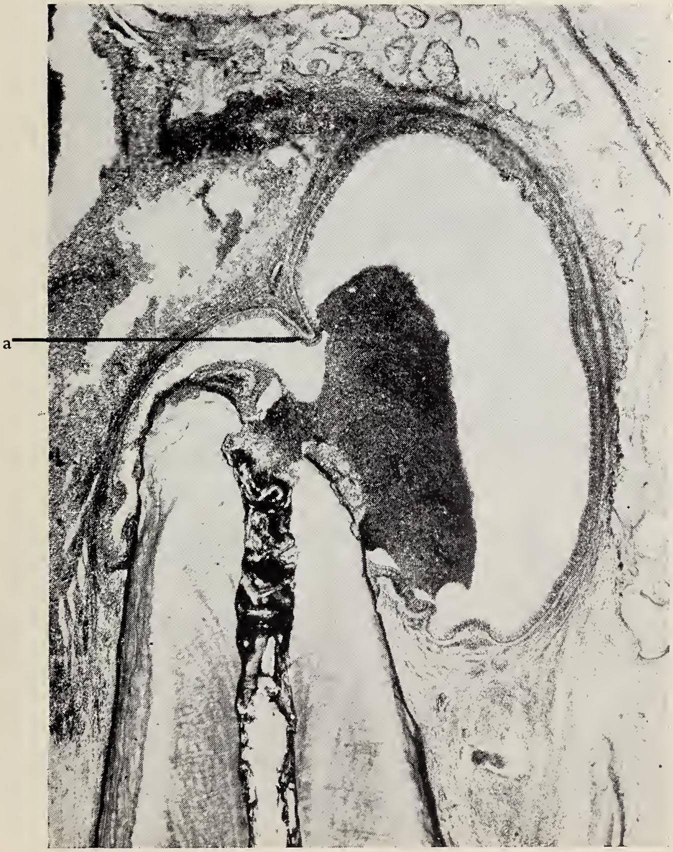


Fig. 32

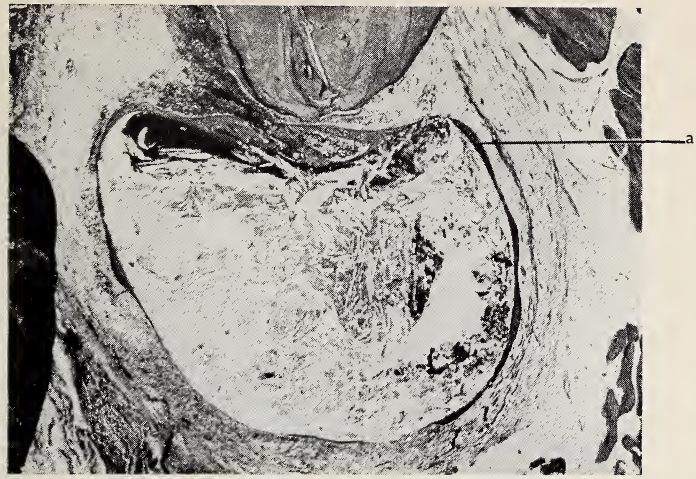


Fig. 33

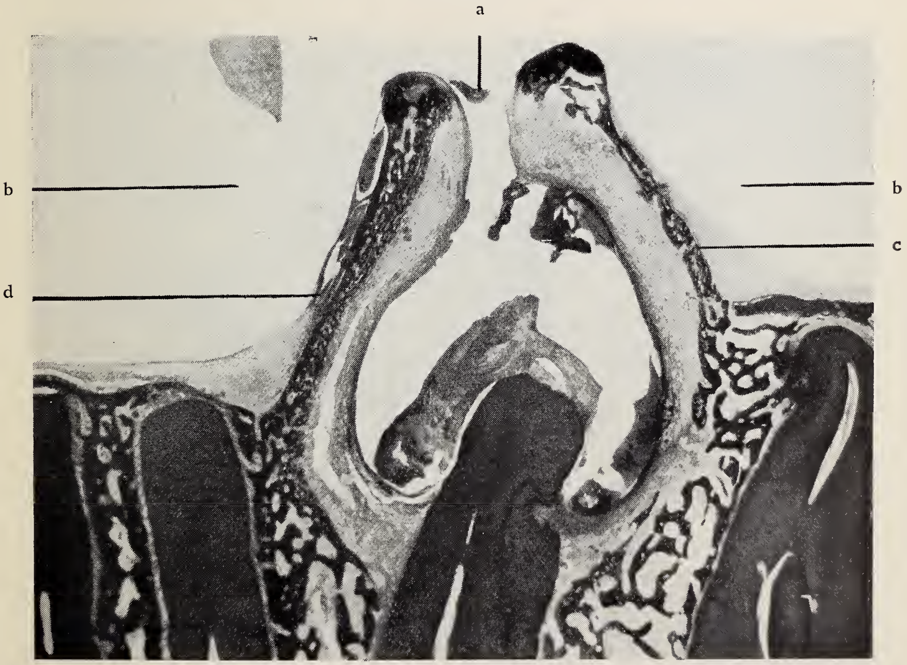


Fig. 35

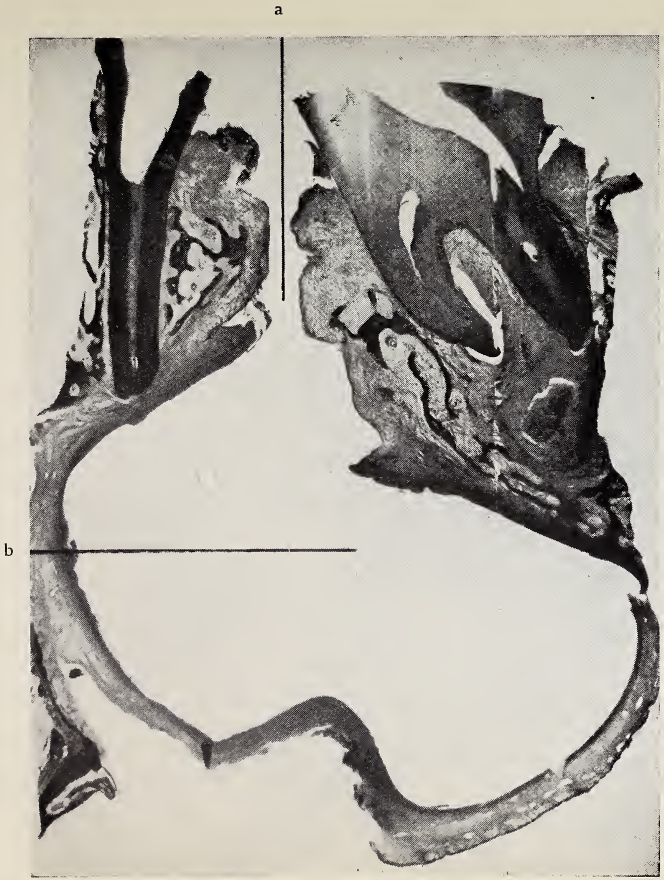
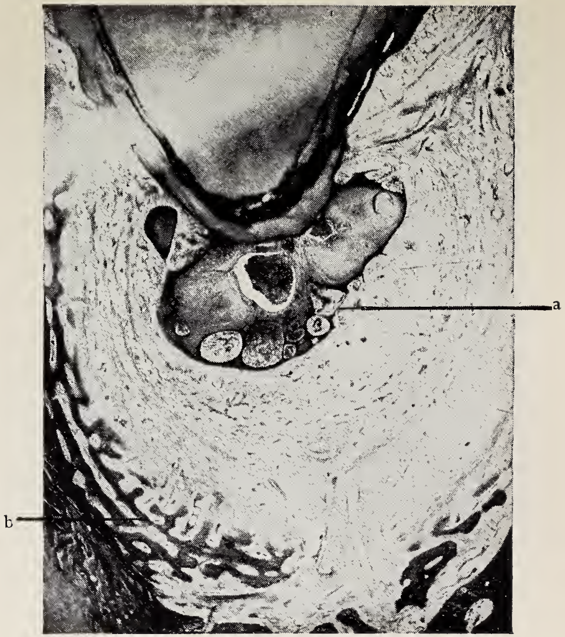


Fig. 36



also know that such a pressure need not be great in order to lead to this result. The origin suggests the therapy. An opening into the cyst wall must be made and care taken that it remains open. This causes the tissue tension to increase and the tissues surrounding the cyst expand at the expense of the cyst. The above described process then carries on in reverse.

The cyst is opened. The first few days the opening is prevented from healing by packing with iodoform gauze. Then the cyst cavity may be filled in with paraffin which promotes the forming of a smooth epithelial surface. In the case of a longer duration of the retrogression of a large cyst, take a modelling compound impression and construct an obturator in order constanly to prevent the opening from closing. This must be worn until the floor of the cyst has advanced so near the opening that the retaining of the obturator becomes impossible. That is the most reliable indication that it may be dispensed with. Smaller cysts can be extirpated as is well known.

In conclusion permit me to call attention to still another illustration (Fig. 36) of an epithelium containing granuloma. Along the bone wall there is evidence of several rows of osteophytic development. This signifies that a diminuition in the strength of the infection has set in some time before death. This was the cause for the reduction of the focus through new bone formation.

All remedies, mentioned in this monography, are manufactured by "Hillel" Remedy Factory Limited, Haifa, P.O.B. 1253.

All metal instruments and appliances including the holder for jonisation are manufactured by Polak, Tel-Aviv, Mohileverstreet 38.

The jonisation apparatus (fig. 25) is manufactured by Ing. E. Furman, Tel-Aviv Allenby 44 and Ing. Heinz Wolff, Tel-Aviv, Pinskerstreet 6.

The other appliances are manufactured by Dentalon Company Limited, Tel-Aviv, P.O.B. 71.